

# The Demand for Consumers' Durable Goods

**T**HE OUTPUT of consumers' durable goods in the postwar years has been at an unusually high rate as a result of a combination of deferred purchasing from the war period and the normal or continuing demand for current replacement and growth. For most such products other than automobiles the direct influence of deferred demand attributable to the wartime gap in production has now become relatively unimportant and the time is approaching or has already arrived when the usual market forces will determine sales of these products.

This article evaluates the effect of these market influences upon the sale of 5 major consumers' durable goods—automobiles, electric refrigerators, vacuum cleaners, washing machines, and electric ranges. For each of these products sales in 1949 and early 1950 are moderately higher than indicated by the analysis of basic, continuing demand factors. For automobiles, this reflects the continued influence of the abnormal replacement demand carried over from the war period which has not yet been satisfied. For the household appliances, special influences are the abnormally high marriage rate in recent years and the boom in house construction—both of which are aftermath-of-war developments.

In addition to these special influences, the demand calculations have a number of limitations. They represent extrapolations of prewar relationships from a period which ended a decade ago. Most of the variables involved have current values well beyond the extreme range of fluctuations in the base period and no adjustment has been made for shifts in distribution of income and population. Accordingly, the results shown are presented as tentative approximations involving a considerable measure of judgment which is only partially avoided by the summaries of estimates obtained by alternative formulations. Finally, the validity of the analysis depends upon the extent to which the many influences affecting the demand for consumers' durable goods can be represented by the 3 or 4 basic factors selected.

## Basic demand factors

The most important basic influence upon the demand for consumers' durable goods is, of course, disposable personal income. If comparison is to be made with unit purchases, an adjustment in income must be made for changes in the general price level. In addition to the effect of the current year's income, demand is also affected by the direction in which income has been changing from the preceding year. In other words, for any given current income, purchases tend to be greater when income has been rising from the previous period than when it has been falling.

This may be due in part to more confidence about future income prospects if income has been rising during the immediate past and a corresponding pessimism associated with shrinking income. Again, there is usually some lag in adjusting spending for many major items including most

services and housing; consequently, when income is rising, cash is a little freer and consumers may tend to trade in their cars or appliances for new models sooner than in a period of stable income. Similarly, when income is falling, consumers may feel pinched for cash and tend to defer purchasing. Also, fewer new models will have been acquired in the recent past if income has been low than if it has been high, and hence purchases will be more likely in the current year than if there had been a wave of recent buying during a period of high income.

Another basic influence affecting consumers' willingness to buy is the price at which the products are offered for sale in relation to the general price level. Despite the problems in obtaining a price series for products which change in quality over a period of years, there is a clear tendency for relatively low prices to stimulate and for relatively high prices to retard buying. For some products, the change in the rate of population growth and family formation in the postwar years as compared with earlier periods is also an important demand consideration.

## Passenger Automobiles

Among the consumers' durable goods, the backlog influence upon demand has persisted longest for automobiles. This is partly a result of the time involved in getting the huge automobile industry into full-scale operation after the end of the war. Although old cars were repaired and kept in use well beyond ages at which they would ordinarily have been scrapped, 2 years elapsed after the war before the total number of cars in use again reached the prewar peak of 29.5 million attained in 1941. It was not until 1949, when registrations exceeded 36 million, that the principal deficiency in the total number of cars appeared to have been made up.

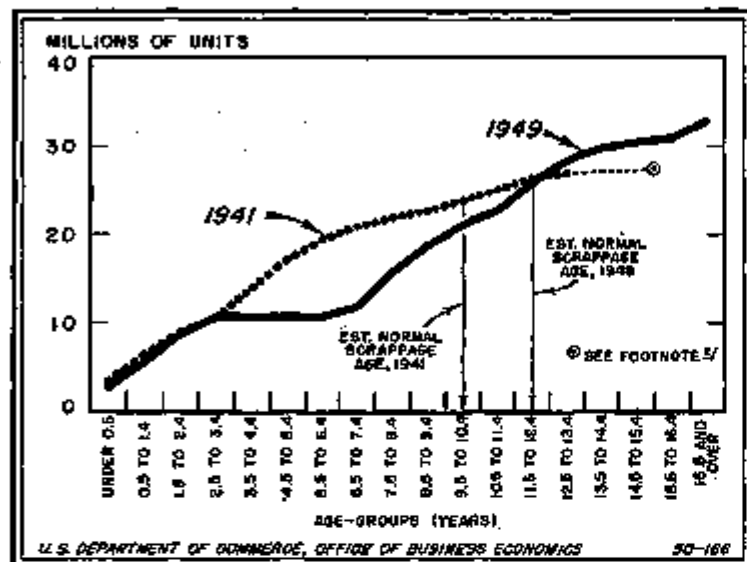
Although the number of cars in use depends upon economic conditions as well as upon the growth in population, it is of some significance that the increase in registrations of 6.8 million between 1941 and 1949 was about the same as the increase in the number of households. A similar trend prevailed between the full-employment years 1929 and 1941, although the growth in the use of cars during this period was retarded by the relatively low income during most of the intervening years. Other evidence suggesting that the deficiency in total cars was about made up by 1949 is the return of more normal rates of scrapping old cars. The apparent scrapping of 2.2 million cars in 1949 was about equal to the prewar average and more than double the number scrapped in other recent years.

## Deficit in younger age cars

Although the total number of cars is about what might be expected on the basis of past relationships, production since the end of the war has not yet brought the car population in the younger age groups to the level which existed before the war. The principal deficiency is in the number of cars which have been in operation less than 8 years, as shown in the accompanying chart of age distribution of automobiles.

In July 1949, there were about the same number of cars less than 4 years of age as in 1941, but 9 million fewer cars between the ages of 4 and 8 years, reflecting the stoppage of production in the war years.

Chart 1.—Cumulative Number of Total Passenger Car Registrations, by Age Groups<sup>1</sup>



<sup>1</sup> Data are as of July 1; normal scrappage age of cars for 1941 and 1949 was estimated by the U. S. Department of Commerce, Office of Business Economics.

<sup>2</sup> Latest data plotted for 1941 are for cars in the 13.5 years and over-age groups, which are not reported separately.

Sources of data: R. L. Polk & Company and Rambert H. Donnelly Corporation; data tabulated from *Automobile Industries*, published by Chilton Company.

Estimates of registrations by age groups are not available beyond the middle of 1949, but sufficient data are available to indicate the effect of the past year's high rate of output upon the stocks of cars in the younger age groups. As of mid-1950, there are approximately 16 million postwar cars, all of which are less than 5 years of age. This is about 2 million more than the number registered in the same age groups as of mid-1941. If the comparison is broadened to include the war years, then the present population of cars less than 9 years of age is 4 million smaller than the similar age-group in 1941, at which time the car population reflected sales during a period of widespread unemployment. The net decline in the number of cars in the lower-age groups during this period of rapid growth in population and substantial rise in real income constitutes an abnormal influence upon the demand for new automobiles.

The contrast between the age distribution of automobiles and that of the major household appliances is indicated by a comparison of output rates in the postwar years with earlier periods. In the 4 years 1946-49, real disposable income was more than 50 percent higher than in the 4 years just before the war; new car registrations, however, were up only about 14 percent whereas refrigerator output was up 50 percent in the latter period and electric washing machine, vacuum cleaner, and electric range output were all more than twice as high as in the earlier period.

It is this gap in availability of cars in the lower-age groups which is augmenting the otherwise strong demand for automobiles in 1950 and is partially responsible for the relatively high prices for which used postwar cars are selling. Although the current age distribution of automobiles has been compared with the prewar situation, it should not be inferred that the difference between the two is a precise measure of the deficiency now existing in the car population.

## Basis of demand estimates

The factors used in the analysis of new car registrations were disposable personal income in the current year, disposable personal income in the previous year—both adjusted for changes in prices—the ratio of automobile prices to the Consumer Price Index, and a time factor.<sup>1</sup> The estimates of new registrations derived from past relationships among these variables were first calculated on a per household basis from disposable income per household and then multiplied by the number of households. Logarithms were used for all the variables except time.<sup>2</sup>

One of the prominent characteristics of the demand for new passenger automobiles is immediately apparent from a glance at chart 2—the wide swings in sales. Thus from a peak of 3.9 million cars in 1929, sales dropped to 1.1 million at the bottom of the depression in 1932.

The most important influence affecting the sale of new automobiles is disposable personal income. Excluding the influence of other factors each increase of 1 percent in real disposable income was associated with a rise of 2½ percent in automobile sales during the base period, and each increase of 1 percent in the ratio of the current to the preceding year's income was associated with a rise of 2 percent in sales.

The other factors had smaller but significant influence upon automobile sales. A rise of 1 percent in the ratio of automobile prices to the general level of consumers' prices was associated with an average decline of 1.3 percent in the number of automobiles sold.

Finally, there was a gradual decline of about 1.5 percent per year in the sale of automobiles per 1,000 households, assuming no change in income per household and no change in the ratio of the price of automobiles to consumer prices generally. Note that this is not the same as saying that total automobile ownership per 1,000 households declined. In fact there was a rise of about 10 percent in the number of automobiles in relation to the number of households between 1929 and 1949.

The downward time trend is attributable to a substantial rise in the average usable life of automobiles. The average age of cars scrapped in 1925 was estimated at 6.5 years. It rose gradually, reaching 10 years in 1940, and is now above 12 years. The increased durability of automobiles is indicated by a rise in the lifetime mileage per car from about 25,000 in 1925 to approximately 100,000 for cars scrapped at the present time.<sup>3</sup>

The estimating equation based upon the four factors discussed accounts for almost all of the fluctuation in the sale of new automobiles during the years 1925-1940, as shown in chart 2. The largest differences between the "calculated" and actual sales were about 360,000 cars in 1937 and 1939, and part of the discrepancy in these years is attributable to seasonal influences in combination with income shifts within each year.<sup>4</sup>

<sup>1</sup> The price used for automobiles is the retail price index of the Bureau of Labor Statistics for the period for which it is available, 1935 to date, linked to an index derived from the wholesale value and number series of the Automobile Manufacturers' Association for prior years. These two series differ in a number of characteristics, the most important of which is that the BLS data represent specific models or makes, whereas the AMA are derived from the total sales in each year and vary with the changing product mix of the industry.

<sup>2</sup> The new registrations estimates are affected by special provisions in certain State laws which result in small differences between sales and registrations of new cars. Neither of these limitations seems sufficiently important to affect seriously the results obtained.

<sup>3</sup> This formulation of the demand equation is somewhat similar to one used by Roos, et al., "The Dynamics of Automobile Demand" published by the General Motors Corp., New York (1938).

<sup>4</sup> Automobile Manufacturers' Association—"Automobile Facts and Figures" 1949.

<sup>5</sup> Although income was a little lower in 1937 than in 1938 and was rising less rapidly in 1937, automobile sales were one-third higher in the earlier year. This may be partially the result of the high proportion of sales during the early part of each year. Sales in 1937 were high partly because the seasonal peak in buying occurred before the beginning of the sharp recession in the latter part of the year. Similarly in 1938, the seasonal peak in buying occurred before substantial recovery from the 1938 recession had been established. Again there may have been more price resistance in 1938 than indicated in the formula. Automobile prices were higher in 1939 than in 1937, although retail prices as a whole averaged lower.

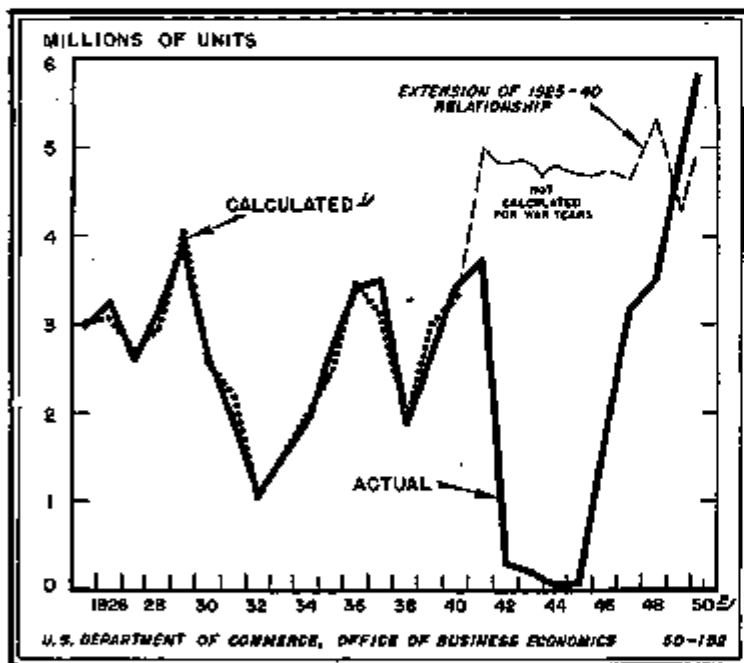
The next largest difference between actual and calculated during the base period was 276,000 in 1931.

### Sales above calculated value in 1949

In 1941 a substantial curtailment in car production kept sales from meeting the demand in that year. After the war, new automobile sales, which were limited in this period only by production bottlenecks, remained below the estimated normal demand exclusive of backlog through 1948. In the latter year actual sales were 3.5 million cars, which was a little lower than in the best prewar years, whereas the demand indicated by the current level of income and prices was over 5 million. In 1949, however, sales exceeded the estimated normal demand for the first year since 1940.

The reduction in the "calculated" demand for automobiles from 1948 to 1949 shown on the chart was partly attributable to a leveling off in disposable income—on a per household basis, income was lower in 1949; but the principal influence on the calculating formula was an advance in automobile prices coupled with a slight reduction in the general level of consumers' prices. Despite a protracted strike in an important sector of the industry, sales increased during the first half of 1950 to an annual rate of about 5.8 million. This is considerably above the "calculated" value, even though the latter is pushed up temporarily by the influence of the National Service Life Insurance payments.

Chart 2.—New Passenger Car Registrations



<sup>1</sup> Calculated from a least squares regression for the years 1925-40. Equation:  $Y = 0.000272X_1 + 0.000000X_2 + 0.000000X_3 + 0.000000X_4 + 0.000000X_5 + 0.000000X_6 + 0.000000X_7 + 0.000000X_8 + 0.000000X_9 + 0.000000X_{10} + 0.000000X_{11} + 0.000000X_{12} + 0.000000X_{13} + 0.000000X_{14} + 0.000000X_{15} + 0.000000X_{16} + 0.000000X_{17} + 0.000000X_{18} + 0.000000X_{19} + 0.000000X_{20} + 0.000000X_{21} + 0.000000X_{22} + 0.000000X_{23} + 0.000000X_{24} + 0.000000X_{25} + 0.000000X_{26} + 0.000000X_{27} + 0.000000X_{28} + 0.000000X_{29} + 0.000000X_{30} + 0.000000X_{31} + 0.000000X_{32} + 0.000000X_{33} + 0.000000X_{34} + 0.000000X_{35} + 0.000000X_{36} + 0.000000X_{37} + 0.000000X_{38} + 0.000000X_{39} + 0.000000X_{40} + 0.000000X_{41} + 0.000000X_{42} + 0.000000X_{43} + 0.000000X_{44} + 0.000000X_{45} + 0.000000X_{46} + 0.000000X_{47} + 0.000000X_{48} + 0.000000X_{49} + 0.000000X_{50}$ , where  $X_1$ =real disposable income per household in 1929 dollars;  $X_2$ =percentage of current to preceding year in real disposable income per household in 1929 dollars;  $X_3$ =percentage of average retail price of cars to consumers' prices;  $X_4$ =year minus 1925;  $Y$ =new private passenger car registrations per 1,000 households. Coefficient of correlation  $R=0.95$ .

<sup>2</sup> Data are for first half of 1950, seasonally adjusted, at annual rates.

Sources of data: Actual—R. L. Polk & Company; calculated—income and households, U. S. Department of Commerce, Office of Business Economics; prices, U. S. Department of Labor, Bureau of Labor Statistics, and Automobile Manufacturers Association.

Some of the alternative formulations of the automobile demand equation tested were judged to be only slightly inferior to the one shown in chart 2. One which differed only in the substitution of the average scrappage age of automobiles for the time trend gave results which are practically identical with those shown in the chart.<sup>5</sup> Those involving linear relationships indicated slightly higher current values than the results of the equation presented and those calculated on a total rather than a per-household basis had current values as much as 10 percent lower.

<sup>5</sup> Scrappage ages are available at intervals of about 5 years. Linear interpolations for the intervening years were used in the regression.

The formula used for automobiles is more complicated than those shown for the other consumers' durable goods, yet the omission of any of the four independent variables resulted in a significant reduction in the explained variation in automobile sales as well as a change in the current values indicated by the equation. For example, omitting the price ratio would increase the 1949 calculated demand value by nearly one-fifth.

On the other hand, the formula used to compute the demand for automobiles is a simplification of the varied forces affecting the sale of automobiles and many important influences are not taken into consideration. Trade-in allowances for used cars affect the total outlay involved in purchasing a new car, and credit terms available influence the monthly carrying cost and in some cases the size of the down payment.<sup>6</sup> These are clearly important elements in individuals' decisions about buying a new car, and shifts in these elements may alter sales appreciably once the backlog demand for automobiles is exhausted.

The age-distribution of automobiles in use is subject to rather substantial changes, as a result of the "boom-bust" character of new automobile sales as well as the wartime gap in production. This point was discussed more fully in connection with chart 1.

Another set of influences which may affect sales differently at the present time than in the prewar years is the change in distribution of income and population. Studies of consumer purchases show that for given income levels, a higher proportion of families buy automobiles in rural areas than in large urban centers. Consequently, the larger rise in farm than in nonfarm income from the prewar period to the present time may increase the demand for cars more than is indicated by the average rise in income. This may be partially offset, however, by the shift in population from the farm areas. In the past decade farm population has declined 10 percent while the nonfarm population has increased about 20 percent.

A contrary influence is the movement of population from the heart of large cities to suburban areas where residents have a greater demand for a car. Another important geographic difference in the car market is that the West has a higher ratio of cars in relation to population than the East, and the West has grown more rapidly in recent years.

A final special consideration not explicitly included in the demand formula is the length of time which cars are used by purchasers of new cars and the total usable life of cars as affected by factors other than income. During the prewar period, there was a gradual increase in the length of life of automobiles. One of the most puzzling problems in connection with the demand for automobiles is the extent to which the rise in scrappage age before the war was due to low income and during the war to the cessation in production. The time trend used in the formula reflects this rising usable life of automobiles, and the continuation of the time trend to the present assumes that the lengthening in life has persisted. The importance of this factor is suggested by the fact that if the average scrappage age should decline to 10 years, which is the estimate for 1940, this would increase the current demand estimate calculated from the formula shown by 15 percent, since the downward time trend should be stopped with 1940 under these circumstances.

Thus, the results of the demand calculation for automobiles shown in chart 2 would be somewhat different if other reasonable formulations of the equation were used, but the general situation indicated by the several alternatives tested is one of strong demand for automobiles at present income levels. The "calculated" demand is not so high, however, as the output rate prevailing in 1949 and the first half of

<sup>6</sup> For a discussion of the role of credit in the demand for other consumers' durable goods—furniture—see *Survey of Current Business*, May 1950, pp. 10-11.

1950, and is considerably below the peak rate attained in the second quarter of 1950. Part of the high sales of new cars in these periods appears to be attributable to the backlog still remaining from the war period.

It is to be emphasized that the demand for new cars is extremely sensitive to changes in business conditions: Sharp fluctuations in new car sales occur in response to relatively moderate changes in income. The demand for new cars is also sensitive to changes in the price of cars. Accordingly, aside from changes in income and the general price level, the possibility of reduction in the final cost of new automobiles to consumers is a factor that could operate to stimulate the demand for cars, and this may be important as the backlog influence wanes. The cost is influenced not only by the price of the cars, but by the added features that have been significant in the postwar period and by the unusually large proportion of higher priced models produced.

### Electric Refrigerators

A high rate of production of electric refrigerators in recent years has largely eliminated the direct influence of the wartime gap in output upon the current demand for refrigerators. An estimated total of 29.5 million refrigerators in use at the beginning of 1950 was 10 million higher than the number in use in January 1942.<sup>7</sup> This rise was 3½ million greater than the increase in the number of households during the same period, but was 4 million smaller than the increase in the number of refrigerators in use during a similar span of years before the war. In fact, this rapid growth in usage was a dominant feature of the demand for electric refrigerators during the interwar period, and as a result, the growth factor tended to obscure the effect of income upon refrigerator sales

until the latter part of the 1930-40 decade. Consequently the calculated values shown in chart 3 may be considered to be less firmly established than for other products where growth is less important.

Refrigerators, like other household appliances, differ from automobiles in that there is no considerable portion of buyers who exchange used for new models in from 1 to 5 years. Nevertheless, obsolescence is an important factor in refrigerator demand. The trend is toward larger models with bigger freezing capacities and larger frozen food storage compartments.

The variables used to calculate the sales of new electric refrigerators were disposable personal income, change in disposable income from the previous year—both adjusted for price changes—and a time factor. During the first few years of the 1926-41 period, refrigerator sales were less than a million units a year and were little affected by changes in income and economic conditions. The sales curve for these years was primarily a growth trend with expansion in each of the depression years except 1932, and as evident from the chart, the demand equation does not correspond closely with actual sales in these years. During the latter part of the period, however, sales were more affected by the level of income and by changes in income.<sup>8</sup>

In the postwar years, sales about coincided with calculated demand, exclusive of backlog, in 1947 and have since been higher than the calculated values. In 1949 domestic sales were 4.3 million, or about 10 percent higher than the calculated value, reflecting the stimulus provided by the housing boom. Some further advance occurred in both categories in the first half of 1950, on a seasonally adjusted annual rate basis.

### Vacuum Cleaners

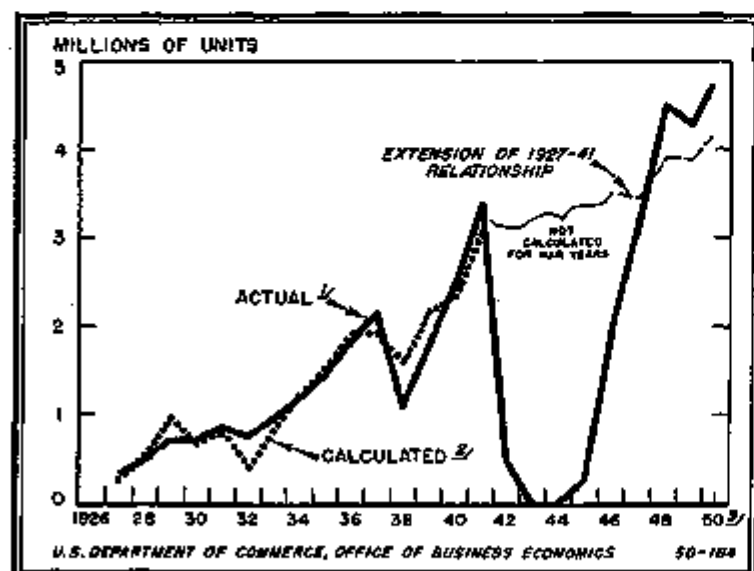
A high rate of production of vacuum cleaners was attained soon after the end of the war and has continued in the intervening years. As a result, the gap in production during the war was apparently made up by the beginning of 1949. At that date total postwar sales of new units equalled sales in the 10 years just preceding the war.

If the backlog element in vacuum cleaner sales has disappeared, the emergent demand based upon current income and other market forces is strong, accounting for sales of 2.8 million in 1949 and a 3.2 million annual rate in the first half of 1950. The calculated value for 1949 is about 14 percent below actual sales both in 1949 and in the first half of 1950. It seems likely that as in the case of other appliances the construction boom in housing is giving a special fillip to demand which is not fully reflected in the demand equation. Another favorable factor which is not included in the demand equation is the smaller rise since the prewar period in vacuum cleaner prices than in the prices of consumer goods generally.

The regression equation used in calculating vacuum cleaner sales is of the same form as that used for automobile sales, except that only the two income variables are used. The regression coefficients given below chart 4 indicate that if the ratio of the current to the preceding year's real disposable income remained unchanged, each increase of 1 percent in real disposable income was associated with a rise of 2.5 percent in vacuum-cleaner sales during the base period. Similarly, aside from the level of income each increase of 1 percent in the ratio of the current to the preceding year's real disposable income was associated with a rise of 1.25 percent in vacuum-cleaner sales. This relationship implies that the sales are influenced three times as much by income in the current year as by income in the preceding year.

<sup>8</sup> Change in disposable income from the previous year is included in the formula although it does not quite meet the usual test of significance by analysis of variance. As explained above, in the earlier years of the period this variable was not related to sales, but it appears to be important in later years.

Chart 3.—Manufacturers' Domestic Sales of Electric Refrigerators



<sup>1</sup> Data represent sales from *Electrical Merchandising*, less exports from U. S. Bureau of the Census.

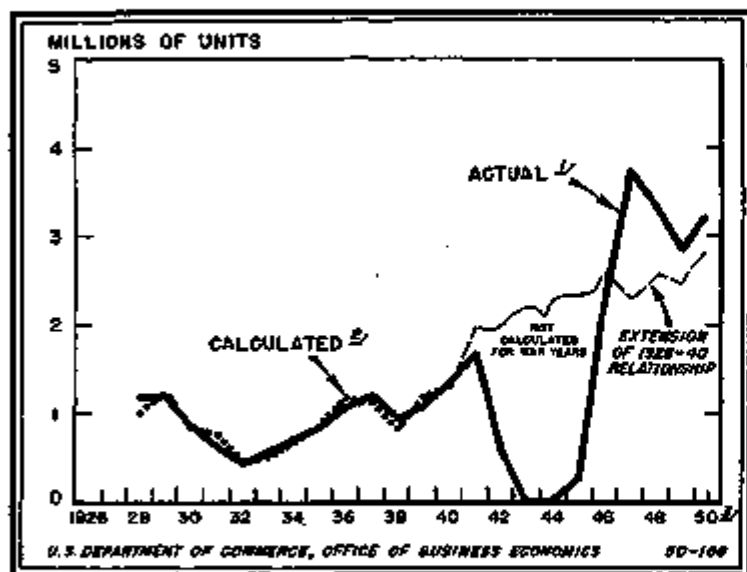
<sup>2</sup> Calculated from a linear least squares regression for the years 1927-41. Equation:  $Y = -2512.7546 + 24.3788 X_1 + 25.6924 X_2 + 2024.2754 X_3$ , where  $X_1$  = real disposable income in billions of 1929 dollars,  $X_2$  = change in real disposable income from preceding year in billions of 1929 dollars,  $X_3$  = time in logarithms (1925 = 1),  $Y$  = manufacturers' domestic sales of electric refrigerators in thousands of units. Coefficient of correlation  $R = 0.90$ .

<sup>3</sup> Data are for first half of 1950, seasonally adjusted, at annual rates.

Sources of data: Actual—McGraw-Hill Publishing Co., Inc., *Electrical Merchandising* and National Electrical Manufacturers Association; calculated—income, U. S. Department of Commerce, Office of Business Economics.

<sup>4</sup> McGraw-Hill Publishing Company "Electrical Merchandising" Annual Statistical and Marketing issues.

Chart 4.—Manufacturers' Domestic Sales of Electric Vacuum Cleaners



<sup>1</sup> Data represent sales from *Electrical Merchandising*, less exports from U. S. Bureau of the Census.

<sup>2</sup> Calculated from a least squares regression for the years 1926-40. Equation:  $Y = 0.000001524 X_1^{1.119} X_2^{0.137}$ , where  $Y$  = vacuum cleaners per thousand households,  $X_1$  = real disposable income per household in 1939 dollars,  $X_2$  = percentage of current to preceding year in real disposable income per household in 1939 dollars. Coefficient of correlation  $R = 0.95$ .

<sup>3</sup> Data are for first half of 1950, seasonally adjusted, at annual rates.

Sources of data: Actual—McGraw-Hill Publishing Co., Inc., *Electrical Merchandising* and Vacuum Cleaner Manufacturers Association; calculated—Income and Households, U. S. Department of Commerce, Office of Business Economics.

Of the various alternative relationships tested, two equations based upon the same two income variables as the one described, together with a time trend, and calculated on a linear basis without explicitly taking into consideration the number of households, showed the same degree of correlation. These alternative equations gave current values of from 2 to 5 percent lower than those in the chart, depending upon the way the time trend was handled. Since the time trend was avoided by the calculation on a per household basis, this equation is preferable. The addition of a vacuum cleaner price variable had little effect upon the degree of correlation in any of the formulations tried and its coefficient showed wide fluctuations.

### Electric Washing Machines

The sale of electric washing machines has been substantially higher in the postwar period than would be indicated on the basis of the backlog carried over from the war period and of any demand calculation based upon prewar relationships similar to those used for the other major consumer durable goods. As early as 1946, sales exceeded the prewar peak in 1941, and were twice as high in 1947 and 1948. In 1949, sales were somewhat lower—3 million units—but they were still about 75 percent higher than the calculated level based upon prewar relationships. (See chart 5.)

### Market broadened by automatic types

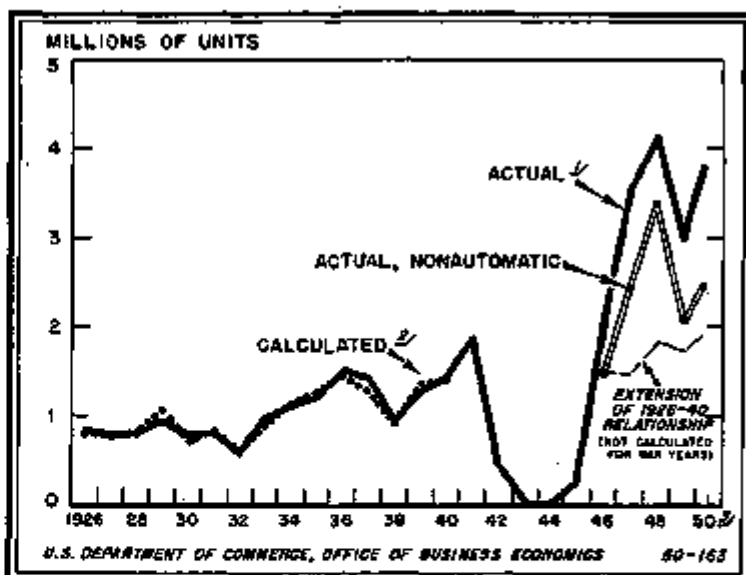
The principal explanation appears to be the rise in sales of automatic type washers, which tapped new layers of demand for home-type (domestic) laundry equipment. The rise of community centers with a number of washing machines serving families in the neighborhood is a new development linked to the automatic washer. The ultimate effect of these community centers depends upon the extent to which they serve households which would otherwise have purchased a

washer for their own use. In many large apartment communities, an individual household washer is not permitted, and in any case they are not widely used in individual apartments.

The postwar housing boom is boosting the sales of washers along with the sale of other major appliances. Some new houses are offered for sale equipped with a washing machine—usually automatic—as a special feature to attract buyers. Since this practice was not common before the war, there was little relationship between new house construction and sales of washers.<sup>3</sup> Accordingly new house construction is not included in the demand equation based upon the prewar period, but it has been an important influence in recent years. Finally, because of its great convenience and ease of operation, the automatic-type washer is broadening the demand by appealing to users who would not have purchased the non-automatic type of machine.

Although the automatic washer was introduced as early as 1937, it was not an important factor in total sales until after the war. Consequently, the demand equation based upon prewar relationships does not take into account the influence of the new type machines, and the extrapolation of the regression equation to the postwar period makes no allowance for the effect of automatic types upon total washer sales. As shown in chart 5, the calculated value for 1949 is about 17 percent below actual sales of non-automatic type washers but far below total washer sales. On the basis of prewar relationships, automatic washers appear to be broadening the demand and speeding up replacement of older units to a greater extent than they are replacing sales of non-automatic washers. A part of the strength in demand for non-automatic machines, however, is to be credited to substantial improvements in these models.

Chart 5.—Manufacturers' Domestic Sales of Electric Washing Machines



<sup>1</sup> Data represent sales from *Electrical Merchandising*, less exports from U. S. Bureau of the Census.

<sup>2</sup> Calculated from a linear least squares regression for the years 1926-40. Equation:  $Y = 719.8801 + 14.0419 X_1 + 39.8066 X_2 - 8.2103 X_3$ , where  $X_1$  = real disposable income in billions of 1939 dollars,  $X_2$  = change in real disposable income from preceding year in billions of 1939 dollars,  $X_3$  = percentage of average retail price of washing machines to consumers' prices,  $Y$  = washing machines in thousands of units. Coefficient of correlation  $R = 0.98$ .

<sup>3</sup> Data are for first half of 1950, seasonally adjusted, at annual rates.

Sources of data: Actual—McGraw-Hill Publishing Co., Inc., *Electrical Merchandising* and American Home Laundry Manufacturers Association; calculated—Income and Households, U. S. Department of Commerce, Office of Business Economics; prices, U. S. Department of Labor, Bureau of Labor Statistics, and *Electrical Merchandising*.

<sup>4</sup> When tested in the formula, the relationship was low and the sign indicated inverse correlation. Residential construction was low in relation to income in the 30's, whereas sales of washers and most other appliances tended to be higher in relation to income in this period than in the preceding decade.



The estimating equation included real disposable income in the current year, the change in income from the preceding year, and the ratio of the price of washers to all consumers' prices. The rate of change in income appeared to be a more important factor affecting year-to-year changes in sales than the amounts of income; however, over a period of several years, the amount of income had the larger influence. This is the result of the fact that changes in income were not progressive, whereas the level of income varied widely over a period of years. For example, between 1948 and 1949 the change in income was about the same as the average for the base period, but the level of income was nearly twice as high as the average.

A number of other formulations of the demand equation including the substitution of time for the price variable showed about the same degree of correlation and gave current values varying within a range of about 5 percent above and below the estimate shown in the chart. All of the equations had the common characteristic of indicating that washer sales were very sensitive to changes in income from one year to the next. All of the equations omitting the change in income from the previous year gave poor results, i. e., low correlations.

### Electric Ranges

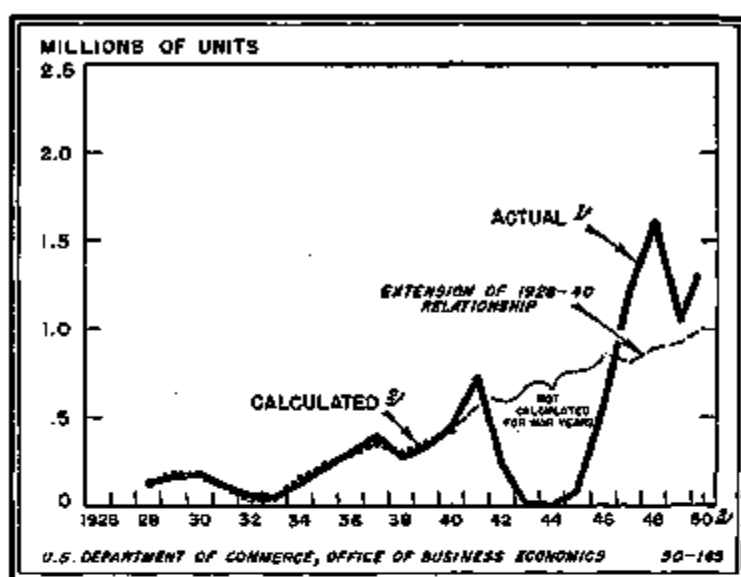
Electric ranges came into wide use at a later date than the other products considered here. Sales were less than 150,000 units in 1929 and reached 250,000 for the first time in 1936. In the past 3 years, however, sales have been above 1 million units each year. This tenfold growth in about 20 years is an important feature of the demand for electric ranges. As explained in the case of refrigerators, the growth trend tends to obscure the effect of changes in income and price upon sales. As a result, the regression equation provides a less adequate basis for determining the basic character of the demand for ranges than for other products which have been in wide use over a longer period of time. Another special condition in the case of electric ranges is that they share the market with nonelectric ranges. Although there are nonelectric refrigerators and washing machines, these types represent a much smaller share of the market than do nonelectric ranges, which account for more than half of the total ranges sold. The nonelectric types have also registered large gains in sales in the postwar years; they are not included in this study only because sales data are not available over a sufficient span of years.

The variables used in the equation are disposable income, adjusted for price changes, the ratio of range prices to the consumers' price index, and a time factor. For 1949, the calculated value is 12 percent less than actual sales. The demand for electric ranges in 1949 and early 1950 appears to be augmented by the high rate of construction and sale of new houses which is lifting the sale of most types of house-furnishings. Of other formulations of the demand equations for electric ranges, one using the same variables but taking into consideration the number of households had about the same degree of correlation and gave 8 percent higher current values. One caution in the interpretation of the estimating equation is that the effect of income is probably understated for the present rate of sale of electric ranges.

### Summary and Conclusions

The demand for automobiles is still favorably influenced by the stoppage in output during the war. While there appears to be no shortage in the total number of cars in use, there is a shortage in the number of younger age cars. Aside from the special influence of the shortage carried over from the war, the "normal" demand for new cars was moderately lower than actual sales in 1949 and the first half of 1950. It would

Chart 6.—Manufacturers' Domestic Sales of Electric Ranges



1 Data represent sales from *Electrical Merchandising*, less exports from U. S. Bureau of the Census.

2 Calculated from a linear least squares regression for the years 1928-40. Equation:  $Y = -2.5773 + 0.2408X_1 - 3.4518X_2 + 18.689X_3$ , where  $X_1$ —real disposable income in billions of 1939 dollars,  $X_2$ —percentage of average retail price of electric ranges to consumers' prices,  $X_3$ —time,  $Y$ —manufacturers' domestic sales of electric ranges in thousands of units. Coefficient of correlation  $R = 0.99$ .

3 Data are for first half of 1950, at annual rates.

Sources of data: Actual—McGraw-Hill Publishing Co., Inc., *Electrical Merchandising* and National Electrical Manufacturers Association; calculated—income, U. S. Department of Commerce, Office of Business Economics; prices, *Electrical Merchandising*.

seem, therefore, that the remaining deferred replacement demand is being worked off gradually.

For the most part, the direct influence of the wartime cessation in production of major household appliances has been made up by unusually high rates of output in the years since the end of the war. However, two special aftermath-of-war influences have been boosting the sale of appliances. The first is the unusually high marriage rate since the end of the war. Marriages reached a peak of 2.3 million in 1946—about twice the estimated normal rate—but have declined in each succeeding year until they are now little above the normal expected rate based upon the age-distribution of the population.<sup>10</sup>

The second factor, related in part to the first, is the current housing boom which is providing a special fillip to the demand for appliances. In the first half of 1950, the National Service Life Insurance dividend payments to veterans was an additional stimulus to demand.

Sales of major appliances in 1949 were moderately below the peak reached after the war, but they were substantially higher than in any year before the war and about 10 to 15 percent above the calculated normal demand for 1949. A further rise in sales and demand occurred in the first half of 1950.

The demand functions derived in this study are based upon the influence of three or four basic factors as measured in the prewar period. Such factors as advertising, salesmanship, and credit terms, as well as changes in the product and in competing products, are not explicitly included in the calculations though they are at times important influences upon sales. These limitations as well as those inherent in any statistical calculation of demand should be borne in mind in interpreting the results of this study. These results should be applicable, however, as a general guide to particular analyses at this time.

<sup>10</sup> S. M. Livingston, "Family Formation and the Demand for Residential Construction," *SURVEY OF CURRENT BUSINESS*, March 1950.